BCBJ solar cells may be prevalent when the cell architecture has metal of one polarity over diffusions of another polarity.

[0005] To compete with other energy sources available on the market, solar cells not only have to be efficient but also fabricated at relatively low cost and high yield. Embodiments of the present invention pertain to novel solar cell fabrication processes and structures that reduce the cost of solar cell fabrication and improve solar cell reliability.

BRIEF SUMMARY

[0005a] In an aspect, there is a P-type diffusion region and a plurality of N-type diffusion regions, wherein the P-type diffusion region touches at least one of the N-type diffusion regions;

a P-type metal contact that is electrically coupled to the P-type diffusion region;

an N-type metal contact that is electrically coupled to the N-type diffusion regions and is directly over the P-type diffusion region;

a first dielectric layer over the P-type diffusion region and the N-type diffusion regions, the first dielectric layer comprising contact holes that expose the N-type diffusion regions but not the P-type diffusion region, the first dielectric layer being configured to electrically isolate the P-type diffusion region from the N-type metal contact, the N-type metal contact being electrically coupled to the N-type diffusion regions through the contact holes; and

a second dielectric layer between the N-type metal contact and the first dielectric layer, the second dielectric layer being disposed between two adjacent contact holes of the first dielectric layer.

[0005b] In an aspect, there is a plurality of diffusion regions of a first conductivity type and a diffusion region of a second conductivity type on a backside of a solar cell, wherein the diffusion region of the second conductivity type touches at least one of the plurality of diffusion regions of the first conductivity type;

a first metal contact that is electrically coupled to the diffusion regions of the first conductivity type and is directly over the diffusion region of the second conductivity type;

a second metal contact that is electrically coupled to the diffusion region of the second conductivity type;

an interlayer dielectric over the diffusion regions of the first conductivity type and the diffusion region of the second conductivity type, the interlayer dielectric layer comprising contact holes through which the first metal contact electrically couples to the diffusion regions of the first conductivity type, the interlayer dielectric being configured to electrically isolate the diffusion region of the second conductivity type from the first metal contact; and

a sacrificial layer between the interlayer dielectric and the first metal contact, the sacrificial layer being disposed between two adjacent contact holes of the interlayer dielectric.

[0005c] In one embodiment, a solar cell is provided, comprising

a plurality of P-type diffusion regions and a plurality of N-type diffusion regions;

a P-type metal contact that is electrically coupled to the P-type diffusion regions;

an N-type metal contact that is electrically coupled to the N-type diffusion regions and is directly over a P-type diffusion region;

a first dielectric layer over the plurality of P-type diffusion regions and N-type diffusion regions, the first dielectric layer comprising contact holes that expose the N-type diffusion regions but not the P-type diffusion regions, the N-type metal contact being electrically coupled to the N-type diffusion regions through the contact holes; and

a second dielectric layer between the N-type metal contact and the first dielectric layer, the second dielectric layer being disposed between two adjacent contact holes of the first dielectric layer.

[0005d] In another embodiment, a process of fabricating a solar cell is provided:

forming a first dielectric layer over a plurality of diffusion regions of a first conductivity type and a plurality of diffusion regions of a second conductivity type on a backside of the solar cell;

forming a second dielectric layer over the first dielectric layer;

after forming the first and second dielectric layers, using a laser to form a plurality of contact holes through the first dielectric layer but not through the second

dielectric layer to expose the plurality of diffusion regions of the first conductivity type but not the plurality of diffusion regions of the second conductivity type; and

forming a metal layer over the first dielectric layer and the second dielectric layer, the metal layer forming metal contacts to the plurality of diffusion regions of the first conductivity type through the plurality of contact holes.

[0005e] In another embodiment, a solar cell is provided, comprising:
a plurality of diffusion regions of a first conductivity type and a plurality of diffusion regions of a second conductivity type on a backside of a solar cell;

a first metal contact that is electrically coupled to the diffusion regions of the first conductivity type and is directly over a diffusion region of the second conductivity type;

a second metal contact that is electrically coupled to the diffusion regions of the second conductivity type;

an interlayer dielectric over the diffusion regions of the first conductivity type and the diffusion regions of the second conductivity type, the interlayer dielectric layer comprising contact holes through which the first metal contact electrically couples to the diffusion regions of the first conductivity type; and

a sacrificial layer between the interlayer dielectric and the first metal contact, the sacrificial layer being disposed between two adjacent contact holes of the interlayer dielectric.

[0006] In one embodiment, contact holes of solar cells are formed by laser ablation to accommodate various solar cell designs. Use of a laser to form the contact holes is facilitated by replacing films formed on the diffusion regions with a film that has substantially uniform thickness. The film thickness as absorption may be tailored to match laser parameters. Dopant depth underneath contact holes may be controlled to increase the laser ablation process margins. The laser configuration may be tailored to form contact holes through dielectric films of varying thicknesses.

[0007] These and other features of the present invention will be readily apparent to persons of ordinary skill in the art upon reading the entirety of this disclosure, which includes the accompanying drawings and claims.

BRIEF DESCRIPTION OF THE DRAWINGS

[0008] A more complete understanding of the subject matter disclosed herein may be derived by referring to the detailed description and claims when considered in conjunction with the following figures, wherein like reference numbers refer to similar elements throughout the figures. The figures are not drawn to scale.

[0009] FIG. 1 schematically shows an example BCBJ solar cell with metal contacts that are formed over opposite polarity diffusion regions.

[0010] FIG. 2 shows a top view of the solar cell of FIG. 1.

[0011] FIG. 3 shows a cross-section of the solar cell of FIG. 1 taken at section A-A of FIG. 2.

[0012] FIGS. 4-6 show cross-sections of a solar cell being fabricated in accordance with an embodiment of the present invention.

[0013] FIG. 7 shows another top view of the solar cell of FIG. 1.

What is claimed is:

1. A solar cell comprising:
a P-type diffusion region and a plurality of N-type diffusion regions, wherein the P-type diffusion region touches at least one of the N-type diffusion regions;
a P-type metal contact that is electrically coupled to the P-type diffusion region;
an N-type metal contact that is electrically coupled to the N-type diffusion regions and is directly over the P-type diffusion region;
a first dielectric layer over the P-type diffusion region and the N-type diffusion regions, the first dielectric layer comprising contact holes that expose the N-type diffusion regions but not the P-type diffusion region, the first dielectric layer being configured to electrically isolate the P-type diffusion region from the N-type metal contact, the N-type metal contact being electrically coupled to the N-type diffusion regions through the contact holes; and
a second dielectric layer between the N-type metal contact and the first dielectric layer, the second dielectric layer being disposed between two adjacent contact holes of the first dielectric layer.

2. The solar cell of claim 1, wherein the second dielectric layer comprises pigmented ink.

3. The solar cell of claim 1, wherein the second dielectric layer comprises polyimide.

4. The solar cell of claim 1, wherein the second dielectric layer has a thickness greater than 500 Angstroms.

5. The solar cell of claim 1, wherein the first and second dielectric layers are configured to have a breakdown voltage greater than 1×10^7 V/cm.

6. The solar cell of claim 1, wherein the solar cell is a backside contact solar cell.

7. A solar cell comprising:
a plurality of diffusion regions of a first conductivity type and a diffusion region of a second conductivity type on a backside of a solar cell, wherein the diffusion region of the second conductivity type touches at least one of the plurality of diffusion regions of the first conductivity type;

a first metal contact that is electrically coupled to the diffusion regions of the first conductivity type and is directly over the diffusion region of the second conductivity type;
a second metal contact that is electrically coupled to the diffusion region of the second conductivity type;
an interlayer dielectric over the diffusion regions of the first conductivity type and the diffusion region of the second conductivity type, the interlayer dielectric layer comprising contact holes through which the first metal contact electrically couples to the diffusion regions of the first conductivity type, the interlayer dielectric being configured to electrically isolate the diffusion region of the second conductivity type from the first metal contact; and
a sacrificial layer between the interlayer dielectric and the first metal contact, the sacrificial layer being disposed between two adjacent contact holes of the interlayer dielectric.

8. The solar cell of claim 7, wherein the sacrificial layer comprises pigmented ink.

9. The solar cell of claim 7, wherein the sacrificial layer comprises polyimide.

10. The solar cell of claim 7, wherein the sacrificial layer has a thickness greater than 500 Angstroms.

11. The solar cell of claim 7, wherein the interlayer dielectric and the sacrificial layer have a breakdown voltage greater than 1×10^{7} V/cm.

12. The solar cell of claim 7, wherein the solar cell is a backside contact solar cell.